

In manual training schools, technical schools, colleges, and post graduate or university research schools, wherever the primary object is to teach and practise the greatest exactness of construction, observation, and investigation; there, of course, nothing but the best should be allowed. These schools are conducted by teachers who understand exactness; it is mostly the public grade schools or high schools that apply for advice as to apparatus for elementary educational purposes.

For high schools and lower grades, the object of whose instruction is to teach general principles and the elements of physics, expensive accurate measuring apparatus is not required. The scholar will learn general laws and principles better by making a rough instrument himself than by merely looking at a highly finished one.

When a teacher desires to maintain a daily weather record as a voluntary observer, he must be provided with the standard apparatus of the Weather Bureau. No cheaper makeshift will do. He need not buy a complete outfit, but what he has must be standard. But when such a record is kept only for local educational purposes as the beginning of a system of training for young pupils, expensive apparatus is objectionable, and the simplest (not always the cheapest) apparatus is most desirable, so that a youth may handle it and easily see how it works and what its source of error may be. For such cases the mercurial thermometer divided on its glass stem, the sling psychrometer, the wind-pressure anemometer, using a pendulous sphere or a square plate, or a Lind anemometer, a home-made syphon mercurial barometer, a Campbell sunshine recorder with a burning glass as a substitute for the expensive sphere, these among others offer the desired simplicity, while sufficient to record the atmospheric phenomena abundantly for educational purposes.

It seems very inadvisable to introduce into elementary schools expensive instruments that are used for exact scientific work or exemplify the best methods of science, such as a Green-Fortin barometer, or the Robinson whirling anemometer, whose structures are complex and whose actions and corrections depend on a theory that can not be demonstrated by simple reasoning adapted to the elementary knowledge of the pupil. Let a youth learn about the more complex and precise physical apparatus after he passes on to the college and higher technical schools. He will then come to understand the sources of error of the so-called "popular" instruments, and understand the lingo of the salesman of "school supplies" who recommends the wooden support of his barometer scale as making an absolutely constant and correct instrument, or his thermometer as equal to those of the Weather Bureau. The best part of education is to teach a man where to go for reliable information on matters that he has not himself thoroughly studied, and how to protect himself against imposition of all kinds.—C. A.

A RIVER AND FLOOD SERVICE ON THE GRAND RIVER OF MICHIGAN.

In view of the recent extension of the River and Flood Service of the Weather Bureau in various parts of the country, we may perhaps call attention to certain minor advantages incidental to this work, whose main purpose is the protection of lives and property threatened by high water. The careful study of the rivers by this service, and the systematic observations carried out at river stations yield information of high value in connection with questions of water power, water supply, irrigation, and other hydrographic problems, and on the larger streams are of the utmost importance in connection with navigation and the work of river improvement. Something on these points is suggested by the following statements:¹

¹ From the December report of the Michigan Section of the Climate and Crop Service of the Weather Bureau, by C. F. Schneider, Section Director at Grand Rapids, Mich.

In view of the destructive floods along the Grand River of Michigan in March, 1904, the Chief of the Weather Bureau has inaugurated a river and flood service on that river; with the Grand Rapids Weather Bureau Office as the river center. River gages have been located at Eaton Rapids, Lansing, Grand Ledge, Portland, Ionia, and Grand Rapids, and readings will be made daily during February, March, and April, and at any other season when necessary. These stations are also equipped with rain gages, and in connection with a special rainfall station at Jackson will furnish the data regarding the height of the river and amount of precipitation.

The Weather Bureau made a careful survey of the river in order to determine the height of the river bed at the various gage stations. In all cases the zero of the gage is the same as the bed of the river, and the danger line was determined by consultation with the principal manufacturing interests. From marks preserved by various citizens the elevation of the high water of March, 1904, was also determined. Much of this data is entirely new and very interesting. The rapid fall of the river between Grand Ledge and Ionia is a feature that has never before been definitely determined, and the great possibilities of that particular section for water power are clearly shown. The drainage area of the Grand River, 5572 square miles, is the second largest in the State.

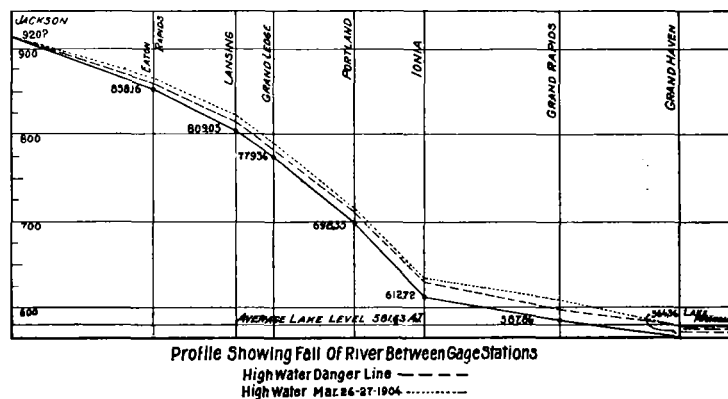


FIG. 1.

The floods of the last decade of March, to which Mr. Schneider refers, were caused by rains that melted the accumulated snow of almost the entire winter while the ground was frozen and unable to absorb any of the water thus suddenly formed. At Grand Rapids about 14,000 persons were rendered temporarily homeless, and the total damage by the flood in that city alone is estimated at \$2,000,000.—F. O. S.

WEATHER BUREAU MEN AS INSTRUCTORS.

Mr. William G. Burns, Section Director, Springfield, Ill., on January 25 addressed the class in physical geography from the Springfield High School, at the office of the Weather Bureau. Mr. Burns described the work of the Weather Bureau and explained the principles of forecasting, the construction of the weather map, and the use of meteorological instruments.

Mr. David Cuthbertson, Local Forecaster, Buffalo, N. Y., states that students from two of the local high schools, and also from the Lancaster, N. Y., High School, visited the office during January and received instruction in elementary meteorology, with an explanation of the instruments and work of the Weather Bureau.

Mr. G. A. Loveland, Section Director, Lincoln, Nebr., delivered two addresses before the Farmers' Institute; on January 5, at Johnson, Nebr., on "Weather Forecasts, how Made, Distributed, and Used," and on January 31, at Fairbury, Nebr., on "The Climate of Nebraska."

Mr. George T. Todd, Observer, Wichita, Kans., on January 19 addressed the preparatory class of Fairmount College. The

instruction consisted of an explanation of the instruments, weather maps and charts, with some remarks on weather forecasting, and the value of the Weather Bureau's records.

Mr. C. F. von Herrmann, Section Director, Raleigh, N. C., on January 16 began his second year as instructor in meteorology at the Agricultural and Mechanical College at West Raleigh. He has prepared a course of twelve lectures, to be delivered before the senior class in agriculture, comprising:

1. The atmosphere; its origin, evolution, and arrangement.
2. The physical properties of the atmosphere; sources of heat.
- 3 and 4. The temperature of the atmosphere.
5. The pressure of the air.
6. Moisture, and its condensation into cloud, etc.
7. The various forms of precipitation.
8. Winds.
9. General circulation of the atmosphere.
10. Cyclones and anticyclones.
11. Weather and local storms.
12. The work of the Weather Bureau.

Mr. Edward L. Wells, Observer, Boise, Idaho, was visited on January 18 by the class in physical geography of the Boise High School, and on January 21 by a number of pupils from one of the public schools. Instruction was given on both occasions in the use of instruments, methods of forecasting, with some reference to long-range forecasting, collecting data, and disseminating information.—*F. O. S.*

METHODS OF MEASURING DURATION OF RAINFALL.

Mr. T. Okada¹ has applied to Japanese records the formula proposed some years ago by Prof. Dr. W. Köppen² for determining the absolute duration of precipitation from observations at regular intervals. Let n be the total number of observations, and r the number of observations with precipitation. Then r/n is the absolute probability of precipitation, and if N be the total number of hours in a month, then $(r/n)N$ is the probable duration of rainfall in hours during the month.

A comparison of the duration calculated by this method from hourly observations with the duration recorded by a very sensitive pluviograph from 1899–1903 shows a mean difference in the total annual duration of 6 per cent, with an extreme difference of 12 per cent. If monthly values are considered, the difference will average 11 per cent of the calculated amount, with an extreme difference of 25 per cent, the extremes occurring always in the colder months, when the duration is least. As a rule the calculated duration exceeds the recorded duration, although in the warmer months the reverse is not infrequently the case. This, in Mr. Okada's opinion, may be explained by the failure of the pluviograph to record the very light snows of winter, and its tendency, owing to the sluggishness of the rain gage, to exaggerate the duration of the light showers of summer. The pluviograph used is a modified form of Rung's weighing gage.³

In order to compare the results computed from hourly observations with those from six-daily and tridaily observations, records were taken for the ten years ending in 1902 from the following eight stations, distributed in various parts of the empire differing greatly in climatic conditions.

Stations.	Latitude.		Longitude.		Altitude.	Mean number of days with rain.
	°	'	°	'	Meters.	
Kumamoto.....	32	48	130	42	17	156
Matsuyama.....	33	50	132	45	32	141
Osaka.....	34	52	135	31	6	113
Hiroshima.....	34	23	132	27	3	129
Nagoya.....	35	10	136	55	45	140
Tokio.....	35	41	139	45	21	142
Hakodate.....	41	46	140	44	3	178
Sapporo.....	43	4	141	21	17	188

TABLE 1.—Mean monthly and annual duration of precipitation, in hours, for the period 1892–1901, computed by Köppen's formula from hourly, six-daily, and tridaily observations.

KUMAMOTO.

Months.	Hourly observations.	6-daily observations.	3-daily observations.	Difference.	
				6-daily minus hourly.	3-daily minus hourly.
January.....	82.9	75.1	87.8	−7.8	+4.9
February.....	87.3	88.7	92.7	+1.4	+5.4
March.....	125.0	126.5	125.7	+1.5	+0.7
April.....	130.3	122.4	136.8	−7.9	+6.5
May.....	121.5	122.8	119.0	+1.3	−2.5
June.....	127.3	126.0	126.7	−1.3	−0.6
July.....	102.3	107.9	117.6	+5.6	+15.3
August.....	49.1	46.9	49.8	−2.2	+0.7
September.....	94.0	87.8	83.6	−6.2	−5.4
October.....	78.8	81.1	77.4	+2.3	−1.4
November.....	59.4	61.9	61.9	+2.5	+2.5
December.....	64.1	62.5	67.0	−1.6	+2.9
Year.....	1122.0	1110.6	1151.0	−11.4	+29.0

OSAKA.

January.....	63.3	62.5	59.5	+10.3	+7.3
February.....	58.8	63.6	62.9	+4.8	+4.1
March.....	100.2	101.2	98.2	+1.0	−2.0
April.....	116.1	115.9	115.2	+20.7	+20.2
May.....	102.0	100.5	100.4	−1.6	−1.6
June.....	112.6	110.2	108.0	−2.4	−4.6
July.....	85.5	90.8	84.8	+5.3	−0.7
August.....	38.8	37.2	36.5	−1.6	−2.3
September.....	110.1	109.4	92.9	−0.7	−17.2
October.....	92.8	95.2	96.0	+2.4	+3.2
November.....	66.3	66.2	44.6	−0.1	−21.7
December.....	47.0	46.8	46.1	−0.2	−0.9
Year.....	961.5	999.4	945.1	+3.7	−16.4

TOKIO.

January.....	69.6	69.9	75.9	+0.3	+6.3
February.....	68.4	69.0	67.7	+0.6	−0.7
March.....	127.3	124.2	124.2	−3.1	−3.1
April.....	137.7	137.5	141.1	+0.2	+3.4
May.....	131.1	128.0	130.9	−3.1	−0.2
June.....	135.2	138.2	138.2	+3.0	+3.0
July.....	114.8	116.1	110.8	+1.3	−4.0
August.....	66.0	66.2	73.7	+0.2	+7.7
September.....	151.4	154.1	156.8	+2.7	+5.6
October.....	133.0	134.7	137.6	+1.7	+4.6
November.....	78.0	78.5	81.4	+0.5	+3.4
December.....	47.2	46.9	41.7	−0.3	−5.5
Year.....	1250.5	1263.3	1280.2	+3.8	+20.7

SAPPORO.

January.....	226.3	225.4	232.9	−0.9	+6.6
February.....	188.7	183.4	184.8	−5.3	−3.9
March.....	200.4	202.4	215.8	+2.0	+15.4
April.....	106.1	108.7	105.8	+2.6	−0.3
May.....	111.8	112.3	116.1	+0.5	+4.3
June.....	101.1	98.6	97.9	−2.5	−3.2
July.....	101.2	99.7	103.4	−1.5	+2.2
August.....	101.4	101.1	110.1	−0.3	+8.7
September.....	118.7	116.6	121.7	−3.1	+2.0
October.....	116.4	113.8	118.3	−2.6	+1.9
November.....	159.7	157.7	165.6	−2.0	+5.9
December.....	212.6	209.0	223.2	−3.6	+10.6
Year.....	1745.4	1728.7	1795.6	−16.7	+50.2

The results for these eight stations, four of which are given in Table 1, show that the durations computed from tridaily and from hourly observations do not differ by more than 4 per cent in the annual means or 18 per cent in the monthly means, while a comparison of the hourly with the six-daily observations shows a still closer agreement. Comparing these figures with the results obtained from his self-recording rain gage, and assuming that the differences in the latter case are due chiefly to instrumental errors, Mr. Okada concludes that the duration of precipitation may be computed from tridaily observations more accurately than it is recorded by the gage. His comparison, however, is inexact, since it is based in one case upon 10-year means and in the other case upon either 4-year means or individual months and years. This method of computation may give approximate mean values, but probably within larger

¹ Journal of the Meteorological Society of Japan, November, 1904, p. 9.
² Zeitschrift Oesterreichischen Gesellschaft für Meteorologie, Band 15, 1880, p. 362.
³ Meteorologische Zeitschrift, 1884, vol. 1, p. 461.